

Course Competencies:

1. Explain the basic elements of a process control system.
2. Setup and maintain instrument devices that control and monitor analog signals.
3. Interpret electrical control prints and Piping & Instrument Diagrams.
4. Install/maintain an instrument loop controlled with a stand alone controller.
5. Install/maintain an instrument loop controlled with a PLC.
6. Explain a process circuit that monitors and controls temperature.
7. Explain a process circuit that monitors and controls level.
8. Explain a process circuit that monitors and controls pressure & flow.
9. Calibrate passive and smart transmitters for pressure, level, flow and temperature.
10. Tune a PID loop that controls flow or level
11. Troubleshoot a Process Control Loop

IND221 Instructional Modules:

M1 - Introduction to Instrumentation Basics (C1, C2, C6, C9)

M2 - P&ID Diagrams and Single-Loop Controllers (C2, C3, C4)

M3 - PLC Controllers for Analog Control (C2, C5)

M4 - Allen Bradley ControlLogix with Analog Control (C2, C3, C5)

M5 - Introduction to the Festo/Labvolt Process Trainers (C2, C3, C5)

M6 - PLC and HMI Controls on the Process Trainer (C2, C3, C5, C8)

M7 - Flow/Pressure Sensors & Controls (C2, C3, C5, C8, C9, C10, C11)

M8 - Level Sensors & Controls (C2, C3, C5, C7, C9, C10, C11)

Module 1: Introduction to Instrumentation Basics

Topics covered:

Open loop and closed loop control

Discrete versus analog signals and voltages

Analog signals, where they are used and what are the most common

How a thermocouple works, and the different types of T/C

How to use a signal generator to simulate a T/C

Cabling and signal transmission basics

Purpose of an instrument transmitter
2 and 4 wire transmitters (simulator and source)
Process Variable and Control Variable
How to use the Signal Generator to create a 4-20mA source
Calibrate an Acromag 250T T/C transmitter

Description: In module 1 the students will learn the basics on open and closed loop control, as well as electrical and pneumatic types of analog signals used in modern day instrument systems. The characteristics of each type of signal will be discussed, as well as the purpose of sensors, transmitters and controllers used in process control. Control circuits will be connected and tested using signal generators and digital multimeters. Students will also do some low level calibration on instrument transmitters. A focus will be on calculating the signals that should be measured and comparing that to process variables.

Module Outcomes:

1. Explain the difference between analog and digital signals
2. Compare the characteristics of a current analog signal and a voltage analog signal
3. Measure a 4-20 mA signal in an instrument circuit
4. Explain the termination of the wires of an instrument signal cable to instrument devices
5. Convert analog signals to a percentage and also to the process variable
6. Explain the purpose of a sensor and instrument transmitter in a process system
7. Wire a transmitter into an instrument circuit
8. Explain the terms: Process Variable and Manipulated Variable
9. Convert a current signal to a voltage signal given a resistance or impedance
10. Calculate percentage of signal within a range, and the signal level based on percentage

Hands-On Activities:

Use the 4-20mA source to a 250 ohm resistor and measure the voltage drop across the resistor
Measure input impedance of a PLC analog input module
Inject a signal using signal generator into an analog input channel and measure the voltage
Connect a transmitter to a 24Vdc P/S and to the input channel of a ControlLogix analog input
Connect a signal generator as a 2-wire transmitter in a circuit to verify signal to analog input
Use a signal generator to simulate thermocouple and measure the output with a DMM

Instructional Materials:

Textbook Reading, Pages 11-18: Process Variable, Range/span, Open vs Closed Loop, Control Loop
Textbook Reading, Pages 293-300 Transmission Signals
PowerPoint converted to PDF for students

Multiple Videos

Lab Exercise Equipment needed:

KCH TH-71B Signal Generator

Digital Multimeter

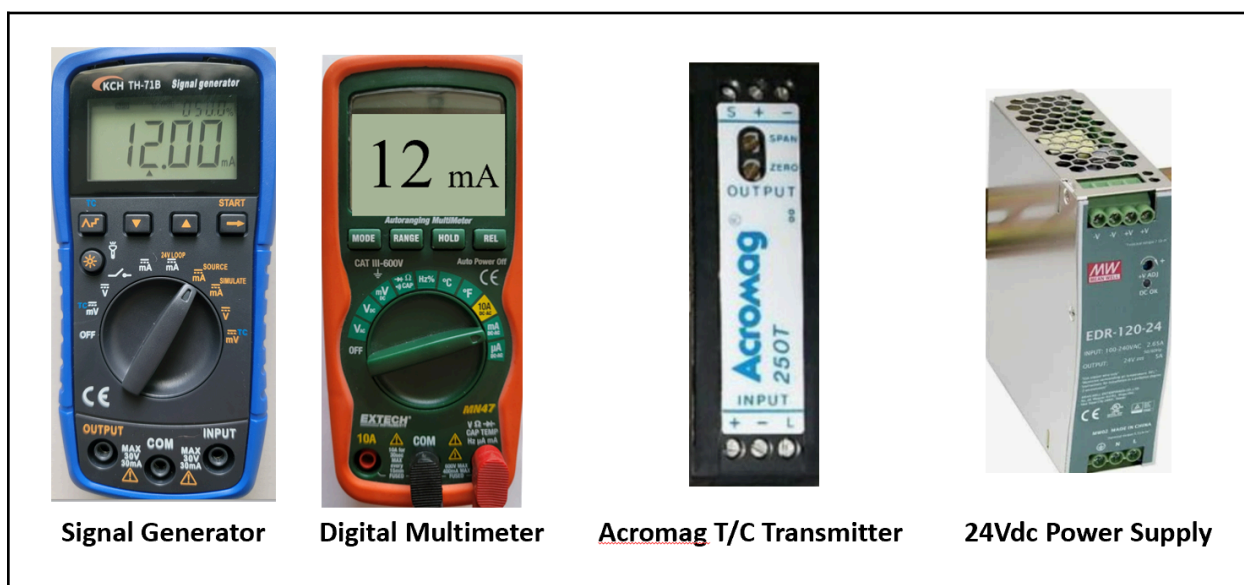
250 ohm precision resistor

Alligator clips and connection wire

Acromag 250T Transmitter - or equivalent the John wants to use

ControlLogix training board

24 Vdc power supply (found on the UDC1200 training unit)



Signal Generator

Digital Multimeter

Acromag T/C Transmitter

24Vdc Power Supply

Module 2: P&ID Diagrams and Single-Loop Controllers

Topics covered:

Interpret the information within an Instrument Tag (Balloon on P&ID)

Determine the location of an instrument based on the Tag information

Interpret the P&ID diagrams

Overview of the UDC1200

Learn the basic operation of the UDC1200 trainer

Explain the basic operation of a proportional (SCR) heat controller

Determining the Unlock codes on the UDC1200

UDC1200 wiring diagram and terminal definitions

UDC 1200 in manual mode driving an output

Lookup parameter settings in the UDC1200 manual and quick reference sheets

UDC1200 in Automatic mode

Connect a mA meter in series with output to determine % out vs mA out

Description: In the first part of module 2 the students will learn how to interpret instrument tag information and Piping & Instrumentation Diagrams (P&ID) used on process equipment. In the second part of module 2, the students will learn the basics on a stand-alone controller (Honeywell UDC1200). A focus will be on controller setup, manual/automatic mode, and the basics on the types of input and outputs that the device has to offer. Students will connect input and output devices and actually control a final element with the controller.

Module Outcomes:

1. Interpret the information within an Instrument Tag (Balloon on P&ID)
2. Determine the location of an instrument based on the Tag information
3. Identify the process loop components on a P&ID diagram
4. Explain the input types that can be used on a UDC1200 controller
5. Determine the unlock codes on a UDC1200 controller
6. Interpret the wiring terminal diagram on the UDC1200 controller
7. Lookup and enter parameters in the UDC1200
8. Change between manual and auto modes and set an output percentage
9. Measure the analog output signal from the UDC1200

Hands-On Activities:

Unlock the UDC1200

Set up the UDC1200 for a T/C input

Run the UDC1200 in both manual and automatic modes

Change the setpoint on the UDC1200

Measure the analog output of a UDC1200 using the signal generator

Change the settings of the UDC1200 back to the original settings

Instructional Materials:

Textbook Reading, Pages 23-29: Piping and Instrumentation Diagrams

Textbook Reading, Page 422 Stand-alone Digital Controllers

PowerPoint converted to PDF for students

Multiple Videos

Lab Exercise Equipment needed:

KCH TH-71B Signal Generator

Digital Multimeter

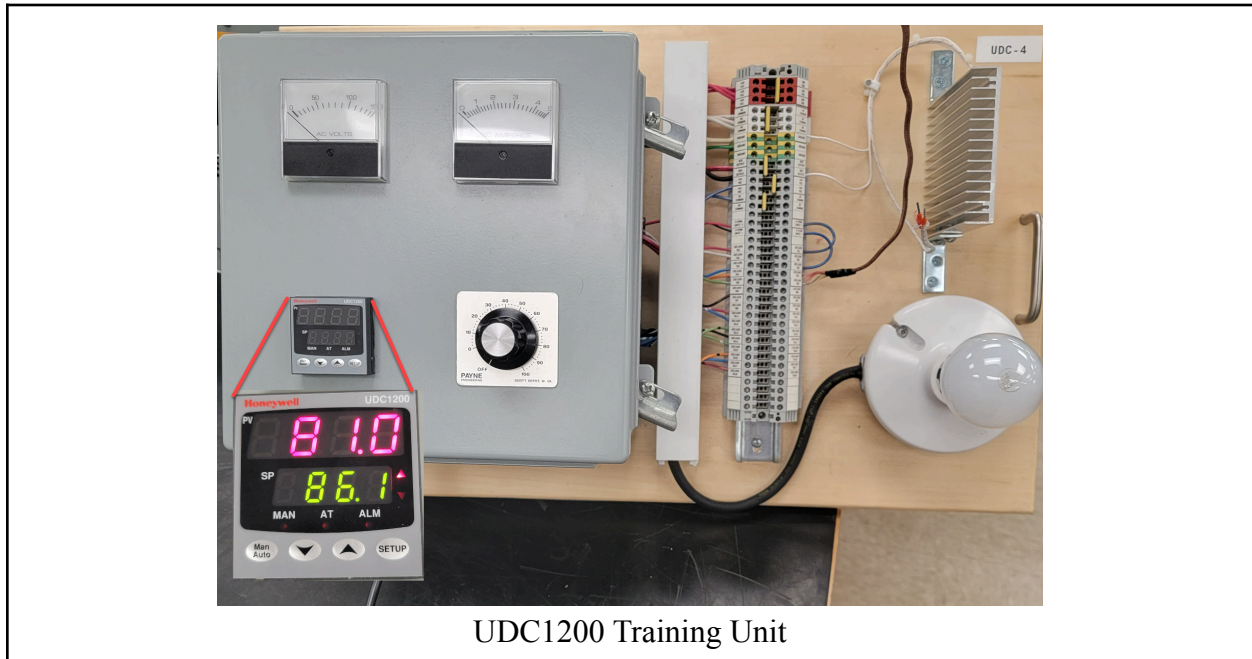
250 ohm precision resistor

Alligator clips and connection wire

Acromag 250T Transmitter - or equivalent the John wants to use

UDC1200 Training Unit

24 Vdc power supply (found on the UDC1200 training unit)



Performance Assessment #1 (after M2 is complete)

Interpret the components on a P&ID

Setup the UDC1200 and manually control the output signal to control the light intensity

Manually reset the UDC1200 to default settings (specified by the Instructor)

Calibrate an Acromag 250T transmitter for a specific temperature range

Connect a transmitter to a 24Vdc P/S and to the input channel of an analog input module (or 250 ohm resistor)

Change the setpoint on the UDC1200

Module 3: SLC-500 PLCs for Analog Control

Topics covered:

Review the SLC-500 hardware and how to use RSLogix500 software

Setup communication from computer to processor with RSLinx

Interpreting the wiring terminal diagram from vendor manuals for T/C and AIO modules

Interpret the vendor terminal diagram and configuration information for the Thermocouple module

Determine the data and configuration addresses for thermocouple module

Connect a thermocouple or thermocouple simulator (signal generator)

Differentiate between the 1746-NIO4V and NIO4I found in the PLC lab

Interpret the switch configuration on the analog I/O module

Determine the data value range for a specific analog signal, input or output

Single-ended versus differential analog input channel wiring
Determine the data and configuration addresses for an analog IO module
Convert a 4-20mA signal value into a digital value
Use the SCP instruction in the SLC-500 to scale to engineering units
Calculate the analog signal output based on a digital value in the SLC-500 processor

Description: In module 3 the students will learn how a PLC is used to monitor and control a process system. The students will use the legacy Allen Bradley SLC-500 modular PLC. Students will learn how sensors and transmitters will connect to the SLC-500 systems, and how the PLC program will be used to control a final control element. The students will use the 1746-NT4 thermocouple module, and the 1746-NIO4V analog I/O combination modules. Students will learn how to make connections to the modules, how to configure the modules, and what SLC-500 addresses will be used to hold the configuration, status and data values. Basic proportioning of data/signals will be discussed when troubleshooting a system.

Module Outcomes:

1. Interpret the wiring terminal diagram on an SLC-500 thermocouple module
2. Interpret the wiring terminal diagrams of an SLC-500 analog I/O module
3. Explain the operation of the T/C module and analog I/O modules on an SLC-500
4. Configure an SLC-500 thermocouple input module
5. Determine what data locations in an SLC-500 analog values will be stored in
6. Interpret the diagnostic indicators on the SLC-500 T/C and Analog I/O modules
7. Explain the operation of a Scale with Parameter instruction in an SLC-500 processor
8. Correlate the analog signals to data values within the SLC-500 system
9. Configure the input channels on the analog I/O combination module
10. Convert an analog signal to a digital data value
11. Convert a digital data value to an analog signal
12. Calculate the percentage within a range of a current, data value, or process variable

Hands-On Activities:

1. Determine the data addresses, configuration and status information for the T/C module
2. Interpret channel configuration data for the T/C module
3. Inject a thermocouple signal into the T/C module with a signal generator
4. Monitor the data value of any of the four channels of the T/C module
5. Configure a T/C channel for a specific type of thermocouple and temperature range
6. Configure the AIO input channels for either current or voltage inputs
7. Interpret the data ranges that the SLC-500 analog I/O module works within
8. Determine the input and output channel data addresses for an analog I/O module
9. Convert a 4-20 mA input signal to a digital value in the SLC-500 processor
10. Explain the operation of an SCP instruction in the SLC-500 processor
11. Determine the analog signal output based on the digital value sent to the module

Instructional Materials:

Textbook Reading, Pages 424-427: Programmable Logic Controllers and HMIs
PowerPoint converted to PDF for students
Multiple Videos

Lab Exercise Equipment needed:

KCH TH-71B Signal Generator
Digital Multimeter
250 ohm precision resistor
Alligator clips and connection wire
SLC-500 training board



SLC-500 Training Unit

Module 4: Allen Bradley ControlLogix with Analog Control

Topics covered:

Go over all the hardware on the ControlLogix Training unit
Determine if the analog input/output modules are wired for voltage or current
Remove/Insert modules and processor on a ControlLogix system
Interpret the information on the scrolling displays on the processor and ethernet module
Interpret the processor diagnostic indicators
Remove/replace removable terminal blocks from the I/O modules
Identify and explain the communication ports on the ControlLogix system
Setup drivers in RSLinx to communicate with the ControlLogix processor
Use RSLinx to determine firmware version of the processor
Create a new project using Logix Designer
Configure the I/O in the project based on the modules in the chassis
Create Alias Tags from the base Tags
Create a ladder logic routine in Logix Designer
Configure the analog modules in the ControlLogix system
Use potentiometers on the ControlLogix trainer to change the analog signal coming into AIN

Description: In module 4 the students will learn how a ControlLogix PLC system operates, the hardware components and the software required for programming. A special focus will be on tags, data types and styles in the ControlLogix controller. Students will learn how to configure analog I/O channels for different types of signals, ranges and engineering units. Students will create projects with the Logix Designer software, configuring I/O and entering the program to control a process.

Module Outcomes:

1. Identify the hardware components of a ControlLogix system
2. Interpret the information on the scrolling displays of the L5571 processor and Ethernet module
3. Explain the operation of the ControlLogix chassis and how I/O modules communicate
4. Determine the processor firmware version using RSLinx
5. Create a project for the ControlLogix processor using Logix Designer
6. Create alias and base tags in a ControlLogix project
7. Download a project and go online using Logix Designer and RSLinx
8. Configure an analog input module for 0-10 Vdc analog input signal
9. Configure an analog output module for 0-10 Vdc analog output signal
10. Interpret the analog Tag structure
11. Predict the analog signal based on the analog channel tag data value

Hands-On Activities:

1. Identify the hardware on a ControlLogix system
2. Insert and Remove the SD module on the ControlLogix processor
3. Interpret the information on scrolling display on the controller and the Ethernet module
4. Determine the modules on a ControlLogix chassis using RSWho within RSLinx
5. Create a new project for the ControlLogix system using Logix Designer
6. Create Alias Tags that are linked to Controller Tags
7. Create a ladder routine made up of relay type instructions using Logix Designer
8. Download and go Online to the controller
9. Monitor the data in a BOOL type of tag

Instructional Materials:

PowerPoint converted to PDF for students

Multiple Videos

Lab Exercise Equipment needed:

KCH TH-71B Signal Generator

Digital Multimeter

250 ohm precision resistor

Alligator clips and connection wire

ControlLogix training unit



ControlLogix Training Unit

Performance Assessment #2 (after M4 is complete)

Configure a thermocouple module on the SLC-500 training unit

Verify the T/C module configuration by simulating a T/C with the signal generator

Configure and set up an analog I/O module on the SLC-500 training unit.

Create a ControlLogix project configuring I/O and creating a ladder program
Configure the ControlLogix analog input module (1756-IF8)
Verify the configuration by injecting a 4-20mA signal into an analog input channel

Module 5: Introduction to the Festo/Labvolt Process Trainers

Topics covered:

Introduction to the components on the Festo/Labvolt Process Trainers
Connecting a flow loop with components on the Process Trainer
Connecting an E-Stop to the electrical circuit on the Process Trainer
Connecting the air source to training unit
Resetting the PF40 VFD to factory defaults
Control the start/stop/pump speed with the potentiometer on the PF40
Change the speed reference parameter to be controlled by a 4-20mA signal
Control the pump speed with a signal generator controlling the PF40
Measure the output pressure on the pump
Read and interpret the Rotameter
Calibrate the I/P converter on the control valve (signal generator and pressure gauge)

Description: In module 5 the students will be introduced to the Festo/Labvolt Process Trainer in Lab E194. This unit will be used to control and monitor pressure, level, flow and temperature process variables in a controlled environment. Students will learn how the motors, pumps, tanks, hoses and VFDs work together to create a fluid circuit, based on a Piping & Instrument Diagram (P&ID). A focus will be on the electrical control system and the safety requirements for a functioning system, as well as learning all of the components used on Process Trainer in this course. Students will also learn how the compressed air supply is used on the system, and will calibrate the I/P transducer found on the main control valve, using a signal generator and a pressure gauge. Students will control the flow of fluid through a circuit using the pump speed (PF40 VFD) and hand valves.

Module Outcomes:

1. Identify the basic components on the Festo/Labvolt Process Trainer
2. Explain the purpose of the different components on the control panel of the Process Trainer
3. Explain electrical power and control circuit on the Process Trainer
4. Connect an E-Stop to the electrical circuit on the Process Trainer
5. Reset the PF40 VFD to factory defaults
6. Connect a fluid circuit on the Process Trainer based on a P&ID diagram
7. Control the speed of the main water pump manually on the PF40 VFD faceplate
8. Control the speed of the main water pump with a signal generator on the PF40 VFD
9. Connect a solenoid operated shutoff valve for the water on the Process Trainer
10. Measure the pressure on at the output of the centrifugal pump on the Process Trainer

11. Calibrate the I/P (Current to Pressure) Transducer on the main control valve

Hands-On Activities:

Identify all the components on the Festo Process Control control panel

Trace through the water flow from tank outlet to the tank drain

Connect a basic water flow loop to cycle water from/to tank

Connect the 208V three phase, 120 V single phase, and compressed air to the control panel

Connect an E-Stop into the main electrical control for emergency shut off

Reset the Powerflex 40 drive for P1 or P2 back to factory defaults

Start/stop and control the speed of the PF40 for P1 or P2 with faceplate controls

Correlate the percentage speed of the pump to the fluid flow

Vary the speed of the pump with the drive faceplate potentiometer

Vary the speed of the pump with a 4-20mA signal from a signal generator

Instructional Materials:

Textbook Reading, Pages 194-198: Digital and Electric Controllers

PowerPoint converted to PDF for students

Multiple Videos

Lab Exercise Equipment needed:

KCH TH-71B Signal Generator

Digital Multimeter

Alligator clips and connection wire

Festo Process Control Trainer

Laptop with PLC and HMI software loaded on it

Pressure Gauge



Festo Process Control Trainer

Module 6: PLC and HMI Controls on the Process Trainers

Topics covered:

Ping the different Ethernet devices on the process trainer (Ethernet module, HMIs & VFDs)

Load .ACD project into the ControlLogix processor

Load .MER file into the Panelview 1000 HMI

Using Logix Designer to load and monitor a ControlLogix Project

Determine the firmware level of the ControlLogix controller

Purpose of FactoryTalk View Studio to develop and HMI project

Purpose of FactoryTalk Machine Edition for loading a project into a PV1000

Using FactoryTalk Machine Edition to run the HMI Project on a computer

Ethernet control of the PF40 VFD and tags created in the .ACD project

Controlling the start/stop and speed of the PF40 with the HMI

Fluid circuit through the control valve

Control the opening of the control valve with manual control on the HMI

Introduce the PID instruction in the PLC project

Calibrate the I/P on the Control Valve
Connect the Control Valve to an analog output channel on the PLC unit
Manually control the position of the Control Valve with the HMI, and view the position
Connect a flow circuit similar to M5 and add the control valve
View the PID instruction in the PLC program and explain how it operates
Measure the pressure drop across the Control Valve while varying the fluid flow

Description: In module 6 the students will use Logix Designer and FactoryTalk View Machine Edition to load a project into the ControlLogix controller, and a runtime file into the Panelview 1000 (HMI) on the Process Trainer. Students will need to learn the function of each Rockwell Software application used to develop and maintain the PLC and HMI units. Students will also focus on the final control elements of a process system (control valves, VFDs and proportional controllers), focusing primarily on the control valve used on the Process Trainer. Students must learn to control the Process Trainer with the HMI, including how to adjust the Control Valve while in the manual mode of the PID instruction. The students will also control a Control Valve with an analog output module from the PLC unit.

Module Outcomes:

1. Load a .ACD project into the ControlLogix controller with Logix Designer
2. Load a .MER file into the Panelview 1000 using FactoryTalk Machine Edition
3. Explain the difference between FactoryTalk View Studio and Machine Edition
4. Explain the purpose of ControlFlash software
5. Explain how the PF40 Ethernet objects in the .ACD project will control the VFD
6. Explain the PF40 tag structure in the ControlLogix project
7. Operate the Process Trainer by manipulating buttons and data values on the HMI
8. Connect a fluid circuit that will utilize the Control Valve on the Process Trainer
9. Connect the Control Valve to the PLC system using the analog output module
10. Explain the purpose of PID instruction in the ControlLogix project
11. Control the Control Valve with the control loop in the manual mode through the HMI

Hands-On Activities:

Ping the different Ethernet devices on the process trainer (Ethernet module, HMIs & VFDs)
Load .ACD project into the ControlLogix processor
Load .MER file into the Panelview 1000 HMI
Using Logix Designer to load and monitor a ControlLogix Project
Controlling the start/stop and speed of the PF40 with the HMI
Control the opening of the control valve with manual control on the HMI
Calibrate the I/P on the Control Valve
Connect the Control Valve to an analog output channel on the PLC unit
Manually control the position of the Control Valve with the HMI, and view the position

Connect a flow circuit similar to M5 and add the control valve

Instructional Materials:

Textbook Reading, Pages 463-476: Control Valves

PowerPoint converted to PDF for students

Multiple Videos

Lab Exercise Equipment needed:

KCH TH-71B Signal Generator

Digital Multimeter

Alligator clips and connection wire

Festo Process Control Trainer

Laptop with PLC and HMI software loaded on it

Performance Assessment #3 (after M6 is complete)

Calibrate the I/P converter on the green control valve

Reset the PF40 VFD to factory defaults, and disable the reverse key

Control the speed of a PF40 with a 4-20mA signal from a signal generator

Configure the PF40 with Ethernet and control with the HMI

Connect the Control Valve to an analog output channel and control manually with the HMI

Connect a flow loop and control with the HMI and manual hand valves



Festo Process Control Trainer

Module 7: Flow/Pressure Sensing and Control Basics

Topics covered:

Flow sensors used in the process industry

Smart Transmitters

Differential Pressure Transmitters

Venturi Tube, orifice plate, paddlewheel flow sensor, rotameter with 3 valve manifold to connect smart transmitter

Rotameter with Reed switch

Laminar versus Turbulent flow

Connecting a circuit to control flow with the control valve

Calibrate the Smart Transmitter to the venturi tube

Learn basics on the Gain, Rate and Reset

Measure Pressure Drop across the Control Valve

Measure the Pressure Drop across the Venturi Tube
Connecting a circuit flow loop with the control valve
Measure air pressure in a pressurized water column using the digital pressure gauge
Measure the pressure drop across the venturi tube with different flow rates
Measure the pressure drop across the high and low pressure ports on the venturi tube
Calibrate the Smart Transmitter to measure flow and connect to venturi tube
Tune the parameters (gain, integral & derivative) of the flow loop
Create an interruption by restricting the flow with a hand valve to see the loop response
Calculate the flow rate based on differential pressure and compare to the rotameter

Description: In module 7 the students will be introduced to the terms and basics of flow technology, as well as the most common flow sensors used in the process industry. Students will learn the basic operation of a modulating control valve that will be used to control fluid flow in a process system. Students will learn how a smart transmitter works, and how it will be calibrated to a flow sensor on the process trainer (venturi tube). During the hands-on portion of the module the students will construct a flow loop on the process trainer, and tune the PID loop with the gain, integral and derivative variables in the PLC program. Students will control the water pump speed and the flow loop through a Panelview 1000 HMI.

Module Outcomes:

1. Explain the operation of a differential pressure smart transmitter
2. Explain the difference between laminar and turbulent flow in a fluid system
3. Explain the operation of a paddlewheel flow sensor in a process system
4. Explain the operation of differential pressure flow sensors (orifice plate and venturi tube)
5. Measure air pressure in a pressurized water column using the digital pressure gauge
6. Measure the pressure drop across the venturi tube with different flow rates
7. Measure the pressure drop across the high and low pressure ports on the venturi tube
8. Explain the purpose of a reed switch when using a rotameter on a flow loop
9. Connect a fluid circuit to control flow on the Process Trainer based on a P&ID diagram
10. Explain the purpose of a PID instruction used to control flow in a ControlLogix controller
11. Explain the Proportional, Integral and Derivative parameters in a PID instruction
12. Calibrate the smart differential transmitter for flow measurement with a venturi tube
13. Tune a flow loop on the on the process trainer using the HMI
14. Monitor the control valve response if a hand valve restricts the fluid flow in the flow loop
15. Explain the purpose of using a 3 valve manifold to remove a flow transmitter from a system
16. Calculate the flow rate based on differential pressure and compare to the rotameter

Reading Assignment:

Fluid Flow Terms, Pg 177-181

Differential Pressure Flowmeters, Pg. 185-192

Mechanical Flowmeters-Rotameters, Pg. 194-197

Mechanical Flow Meters-Paddlewheel Meters, Pg. 201

Venturi Tube Cut Sheet (Festo)

Lab Exercise Equipment needed:

KCH TH-71B Signal Generator

Digital Multimeter

Alligator clips and connection wire

Festo Process Control Trainer

Laptop with PLC and HMI software loaded on it

Digital Pressure Gauge on the Process Trainer



Festo Process Control Trainer

Module 8: Level Sensing and Control Basics

Topics covered:

Connecting a level circuit using hydrostatic pressure to measure level
 Measure the hydrostatic pressure of the tank, both empty and full
 Calibrate the DP to measure level
 Connect DP to analog input channel 0
 Connect CV to analog output channel 0
 Tune the loop to respond to interruptions such as cracking a hand valve
 Connect a second control valve between bottom of column and the tank
 Control CVfill with HMI in manual mode and CV drain with a signal generator
 Measure the CVfill response as the CV drain is opened more, draining more water
 Connect the CV drain to analog output channel 1 to control with HMI in manual mode (50-100%)
 Measure the response of CV fill as CV drain drains more water

Description: In module 8 the students will be introduced to the terms and basics of level sensing technology, as well as the most common level sensors used in the process industry. Students will learn how to calculate hydrostatic head pressure of a tank holding water that can be used to directly measure liquid level. Students will learn how a smart transmitter works, and how it will be calibrated to a level sensor on the process trainer (hydrostatic pressure). During the hands-on portion of the module the students will construct a level loop on the process trainer, and tune the PID loop with the gain, integral and derivative variables in the PLC program. Interruptions to the level in the tank will be injected by opening a drain valve to a balanced system, and monitoring the controller response.

Module Outcomes:

1. Calculate the hydrostatic pressure of a water column
2. Explain the operation of a capacitive level sensor on a level loop
3. Explain the operation of radar and ultrasonic level sensors
4. Explain the operation of load cells for sensing the weight of a wet or dry tank
5. Calibrate the differential pressure transmitter for level to measure the hydrostatic pressure
6. Connect a fluid circuit to control level on the Process Trainer based on a P&ID diagram
7. Explain the purpose of a PID instruction used to control level in a ControlLogix controller
8. Explain the Proportional, Integral and Derivative parameters in a PID instruction
9. Tune a level loop on the on the process trainer using the HMI
10. Monitor the control valve response if a hand valve drains fluid from the column
11. Connect a second control valve between bottom of column and the tank
12. Measure the response of CVfill as CVdrain drains more water

13. Connect the CVdrain to analog output channel 1 to control with HMI in manual mode (50-100%)
14. Measure the response of CVfill as CVdrain drains more water

Reading Assignment:

Hydrostatic Pressure, Pg 95-98

Hydrostatic Head Pressure, Pg. 133-138

Radar and Ultrasonic Level Sensing, Pg. 157-162

Load Cells for measuring weight in vessel, Pg. 164-166

Lab Exercise Equipment needed:

KCH TH-71B Signal Generator

Digital Multimeter

Alligator clips and connection wire

Festo Process Control Trainer

Laptop with PLC and HMI software loaded on it

Digital Pressure Gauge on the Process Trainer



Festo Process Control Trainer

Performance Assessment #4 (after M8 is complete)

Connect a flow loop using a venturi tube and DP transmitter

Connect a level loop using a DP transmitter, calibrated for level

Connect the control valve to analog output channel 0

Connect the DP transmitter to analog input channel 0, and a 24 Vdc supply

Tune the level loop with the parameters on the HMI

Calibrating a RTD transmitter

https://www.google.com/search?q=calibrating+temperature+transmitter&sxsrf=AB5stBgt5XjjO6hR9VONIN9AFNI3-BC1MA%3A1691333824966&source=hp&ei=wLTPZJ3KOLaaptQP9de9iAY&iflslg=AD69kcEAAAAAZM_C0FOijr4BUKcW3QKEWsErBwDgq74o&oq=calibrating+temperature+tra&gs_lp=Egdnd3Mtd2l6IhtjYWxpYnJhdGluZyB0ZW1wZXJhdHVyZSB0cmEqAggAMgUQABiABDIGEAAYFhgeMgYQABgWGB4yBhAAGBYHjIGEAAYFhgeMggQABiKBRiGA0i7hAFQjQVY6khwAXgAkAEAmAGFAaAB4hSqAQOxOS44uAEBYAEA-AEBqAIKwgIHECMY6gIYJ8ICBBAjGCfCAgcQIxiKBRgnwgIEAAYigUYkQLCAgsQLhiABBixAxiDAcICERAUgIAEGLEDGIMBGMcBGNEdwgILEC4YgAQYxwEY0QPCAggQABiABBixA8ICDhAuGIAEGLEDGMcBGNEdwgIOEC4YigUYxwEYrwEYkQLCAgsQABiKBRixAxiDAcICBAuGIAEGLEDwgIREC4YigUYsOMYgwEYxwEY0QPCAhAOLhiABBgUGlcCGMcBGK8BwgITEC4YFBivARjHARiHAhiSAxiABMICCBAAGIAEGMkDwgILEAAYgAQYsQMYgwHCAhAOLhgUGK8BGMcBGlcCGIAEwgIEEC4YsOMYgATCagoQABiABBgUGlcCwgILEC4YgAQYxwEYrwHCAG4QLhiABBixAxjHARivAcICDRAAGIAEGLEDGEYY-QHCAggQABgWGB4YDw&scient=gws-wiz#kpvalbx=_2rTPZK6vDZuaptQPpN-WgAc_49

Calibrating a 2 wire thermocouple transmitter

https://www.google.com/search?q=calibrating+thermocouple+transmitter&sxsrf=AB5stBjb7YH_6ozq3rAxn4TtgVZw9z7dDA%3A1691333850226&ei=2rTPZK6vDZuaptQPpN-WgAc&ved=0ahUKewiuhNvKpciAAxUbjYkEHaSvBXAQ4dUDCBA&uact=5&oq=calibrating+thermocouple+transmitter&gs_lp=Egxnd3Mtd2l6LXNlcnAiJGNhbGlicmF0aW5nIHRoZXJtb2NvdXBsZSB0cmFuc2lpdHRlcjIFEAAAYogQyBRAAGKIEMgUQABiiBEiuPICuCFjuJnABeAGQAOCYAZkBoAHVCAoBAzYuNrgBA8gBAPgBAcICChAAGEcY1gQYsAPCAGYQABgHGB7CAggQABgHGB4YD8ICCBAAAGAgYBxgewgIEAAYigUYhgPCAGYQABgeGA_CAggQABgeGA0YD8ICCBAAAGIkFGKIEwgIEECEYCuIDBBgAIEGIBgGOBgg&scient=gws-wiz-serp#fpstate=ive&vld=cid:6649eab8_vid:15S1buZsXWk

Checking thermocouple with ohmmeter

https://www.youtube.com/watch?v=3_lwLOuxr0Y&t=110s

Omega Engineering youtube channel

<https://www.youtube.com/user/OmegaEngineering1>

Cold junction compensation

<https://www.plcgurus.net/what-is-a-thermocouple-cold-junction-compensation/>